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Inaugural Essay on

"The Functions of the Lungs"

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Perhaps there is no enquiry in the whole range of physiology in a more unsatisfactory state than that, concerning the ventilation of the blood in the lungs, and the production of animal heat. Ever since the early ages, the subject has occupied the attention of the physiologist, and many attempts made to explain the phenomena but even to the present day, though the researches of modern chemistry have disclosed volumes of facts, and the ingenuity of able theorists applied them to an explanation of this curious subject, yet we have still to regret the "thick darkness which lies over it".

Before proceeding to a brief survey of the functions of the lungs it may be necessary to take a hasty glance at these organs

Situated at the root of the tongue, and attached to the Os Hyoides, is an "irregular cartilaginous tube", forming the upper portion of the windpipe

and which is denominated "the Larynx". From the larynx is appended a "cylindrical canal" four or five inches in length - terminating in the thorax by two ramifications called Bronchia which enter the lungs.

The lungs occupying the greater portion of the thorax are a pair of "elastic, light, and spongy organs" — suspended by the tracheal tubes and large blood vessels and in size exactly adap=ted to the pleura, which they fill completely. An exquisitely fine duplicature of this membrane surrounds the lungs — separates them from each other by a septum, which from its going between the two is called mediastinum, and lines the entire cavity of the thorax.

The structure of the lungs is very delicate, consist=ing of cells which communicate with the branches of the trachea that ramify through them in every part. These cells are extremely small.

and the membranes of which they are composed very thin. Each of the extreme ramifications of the bronchia appears to be surrounded by a portion of this cellular substance.
Constituted by the cells of the lungs are a number of various angular figures denominated "lobuli". They are covered by the proper coat of the lungs which is extremely delicate, and closely connected to the general covering derived from the pleura. Between the lobuli where they are in contact with each other, there is interposed a portion of common cellular substance, which is very distinct from the cellular structure which communicates with the ramifications of the bronchia.
Upon the membranes composing the air cells the pulmonary artery and vein ramify most minutely, by which the blood is exposed to the full action (whatever this may consist in) of the

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atmospheric air.
The "pulmonary artery" arising from the base of the right ventricle divides into two arteries one to each lung. On reaching the substance of these viscera, these vessels divide into as many branches as there are principal lobes. From these branches there arise others which again subdivide into lesser ones until they become capillary and continuous with the radicals of the pulmonary veins.
The "pulmonary veins" formed from the extremities of the artery unite into trunks, which progressively enlarging emerge from the lungs and open four in number into the left auricle of the heart.
The Pneumo-gastric or eighth pair of nerves, furnishes in its descent from the cranium to the larynx on each side a branch called the recurrent. it then accompanies the trachea and the bronchia to the membrane of both of which it is principally destined - but it gives branches to the cardiac

pulmonic plexuses which are in a great measure formed by the great sympathetic.

Respiration. This is one of the most important functions of the living body. All animals have an apparatus calculated to perform those changes on the blood necessary to their existence, but it is different in the different classes. In the "cold blooded" animals the exterior of the body is often sufficient for this process being perforated by numerous openings by which air is introduced down to the interior of the vessels. — Fishes are provided with a membranous apparatus supported by cartilages having a parallel arrangement called "gills". In Reptiles the heart has but one auricle and one ventricle — the pulmonary artery in them arises from the aorta and conveys but a small portion of the blood. But in the "warm blooded" animals the respiratory surface is very large, and the apparatus placed

in the centre of the body – a class in which birds occupy the first space from the vast extent of their lungs which reach into the abdomen and communicate with the principal bones of the skeleton.

Let us now examine the change produced on the air by inspiration. The atmospheric air by chemical analysis has been found to contain by weight twenty seven parts of Oxygen seventy two of Nitrogen and a small portion of carbonic acid. After its expulsion from the lungs we find it considerably altered – the quantity of Oxygen is diminished – the Nitrogen remains nearly the same, while the quantity of carbonic acid is much increased.

What effect has this aeration produced on the blood? The blood, which the veins convey to the heart, and which the right ventricle transmits to the lungs is of a dark colour and heavy.

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its temperature 98° F. – it coagulates slowly, and there is seperated from it a considerable quantity of serum. The blood which is brought by the pulmonary veins to the left side of the heart and which is conveyed to all parts of the body by the arteries, is on the contrary of a florid red color; it is frothy, lighter, and warmer by two degrees. It likewise coagulates more readily and contains a smaller quantity of serum. – Thus far we have travelled on sure grounds conducted by the light of chemical analysis – beyond this point all is lodged in thick obscurity. —— One of the earliest theories on this subject was that the oxygen of the atmosphere unites with the Hydrogen and carbon of the blood and in this way a great quantity of water was formed and carbonic acid – but it is only necessary in order to show the fallacy of this theory to revert to the simple fact that the heat necessary to produce this combustion could

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not probably be sustained by the delicate texture of the lungs. Besides it is not necessary to the production of the "peculiar perspiration" that the water which is its base is formed of the oxygen of the air suddenly united to the hydrogen of the blood in the act of respiration since the same exhalation is observed on all the surfaces of the human body. We may with greater reason suppose that the oxygen of the inspired air had combined with the dark blood returned by the vena cava and in the course of the circulation unites with ~~with~~ the carbon which is afterwards expelled by the lungs. But we are here met by the inquiry, from whence is the carbon derived?

The blood is the agent by which all parts of the system are stimulated to action - furnishing them with the materials of the fluids they secrete or the molecules by which they grow or are repaired. To supply the loss occasioned by its thus

passing through the different tissues, chyle is taken up by the lacteals and is deposited in the circulation. Into the composition of chyle carbon enters as an ingredient in large quantities, to eliminate which those changes take place already noticed.

How far are the nerves concerned in respiration?

Respiration which is completely under the influence of the brain as far as relates to its mechanism is less dependant on it in regards to the action of the lungs on the blood and the combination of that fluid with oxygen, which is the essential object of that function. That this is the fact is proved by the experiments of Le-Gallois and others, showing that the artificial respiration of the breast after the division of the eighth pair produced the same changes on the blood as before their division.

Connected with respiration and the changes which the blood undergoes in the lungs are the considerations

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of animal temperature. All living bodies have a temperature peculiar to themselves and independent of that of the atmosphere. The human body whether under the frozen climate of the polar region or under the burning atmosphere of the torrid zone, preserves the same degree of warmth. When nature designs the blood to be warm she places the circulatory apparatus in the centre of the body and which is generally of great extent.

Calorie in a latent state or in combination with bodies is disengaged when from a gaseous form they become liquids or when from being liquids they become solids. During the formation of carbonic acid in the course of the circulation (at the expense of the oxygen absorbed in the lungs) calorie is disengaged. Yet the lungs are not the only organ by which the temperature of the human system is maintained. The experiments of Druikshanks show that the air in contact with the skin undergoes

changes similar to those effected in respiration the oxygen disappearing and carbonic acid formed. During digestion particularly of certain kinds of foods, a considerable quantity is evolved. In fact we see caloric disengaged whenever condensations, new combinations, or decompositions acids and bases take place in a constant and uninterrupted manner in physiological phenomena. It is not then astonishing that caloric should be continually disengaged by the exercise of the functions, and these phenomena can reasonably be referred to a "chemical power" peculiar to living bodies.

The vital principle which directs this "living chemistry" keeps the temperature of the body within certain limits. If we enquire into the causes which enable the body to resist the admission of a degree of heat superior to that which habitually belongs to it, we shall find that cutaneous

perspiration acts very powerfully in lowering the temperature, and as this evaporation increases with the temperature, it should seem as if this function sufficed to moderate the heat of the body and to restore the equilibrium. The evaporation of fluids or their solution in air is the most powerful means of cooling bodies, and the hands may be cooled to such a degree as to feel benumbed by being wetted and moved in a dry and warm air "The body resists cold and preserves its temperature in the midst of a frozen atmosphere." This is accomplished by an increase in the activity of the organs augmenting the sum of the combinations by which calorie is disengaged. Accordingly if the atmosphere in which man is placed be below the temperature of his body, his internal functions go on with redoubled energy; and as more combinations are necessary more aliments are required and nutrition becomes more active. If

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on the contrary the air be found warmer than the body the skin supplys a greater evaporation and the fluids which would have yielded to combinations of two multiplied a character and exhaled.